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ABSTRACT

This study was conducted to identify the cognitive style of students enrolled in a graduate program in library and information science and to examine the relationship between the identified style and other personal variables, such as age, undergraduate major, preference for future institutional affiliation, and preference for future functional area. The McKenney-Keen model was used to characterize cognitive style in information gathering and information evaluation, while the Group Embedded Figures Test (GEFT) was used to measure the subjects' field dependence/field independence. Of the 179 University of Maryland students who completed the GEFT, 61 completed a battery of eight additional tests designed to discriminate along the two dimensions of the McKenney-Keen model. Personal information was gathered through a self-administered questionnaire. The report details the hypotheses, methodology, and results of the study, including (1) demographics of the sample, (2) findings of the battery of tests in relation to the McKenney-Keen paradigm, and (3) relationships between field dependence/field independence and personal/professional characteristics. Tables and figures illustrate the findings. Eleven references are cited. (FM)

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Cognitive Style in Library/Information Science Education

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ABSTRACT

Cognitive Style in Library/Information Science Education

The major objective of this research was to identify personal and cognitive variables which would reasonably predict performance by students on specific tasks in library/information science. Two concerns, the diverse background of the students and the emergence of new role requirements within the field, led to the use of cognitive style theory. A two-dimensional model (information gathering/information evaluation) and the field dependent/independent dimension of cognitive style were selected for examination. Students were successfully cahracterized, the two-dimensional model was verified, task variables were analysed, and a set of potential research questions was generated.

INTRODUCTION

The objective of the exploratory research reported in this paper is to identify the cognitive style of students enrolled in a graduate program in library and information science. A second objective is to examine the relationship between the identified style and other personal variables, such as age and undergraduate major, each of which has been related to cognitive style in previous research. The study also relates cognitive style to preferences for future institutional affiliation, such as special or academic library, and future functional area, such as reference, archives, technical services.

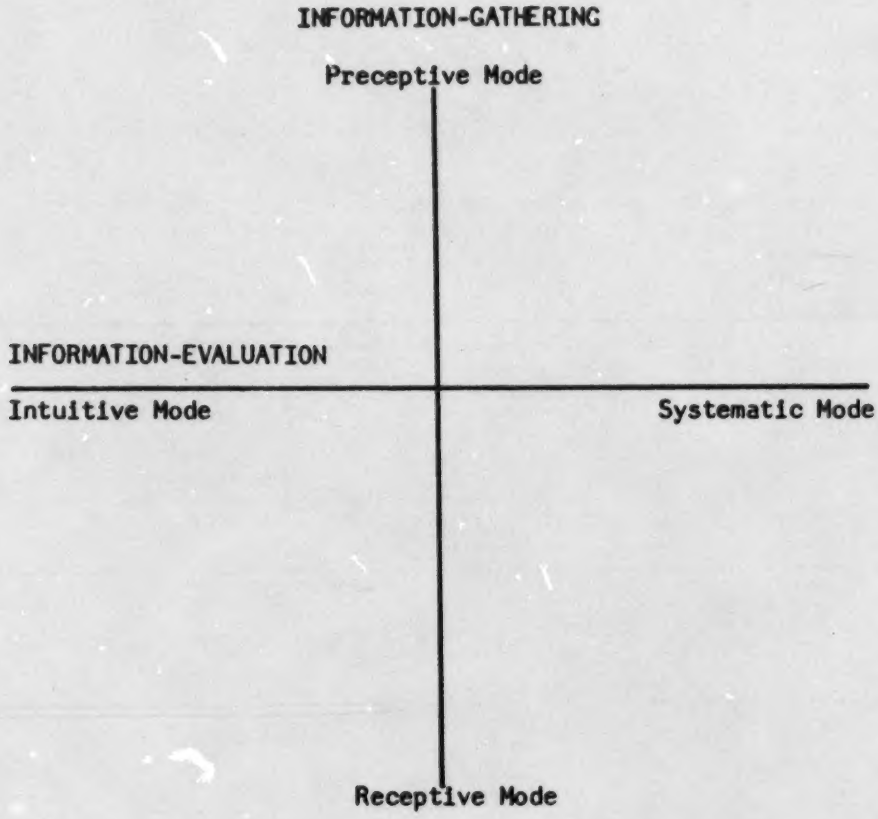
Two approaches are used to characterize cognitive style in this study. The first involves use of the McKenney-Keen model of cognitive style (Keen, 1973). The second, which is related to the first, involves characterizing subjects on the field dependent/field independent cognitive style dimension.

The McKenney-Keen model was selected for this study because it is two-dimensional and thus provides greater explanatory power than the typical unidimensional cognitive style approaches. And, more importantly, the two dimensions are consistent theoretically with the tasks, roles, and settings typical of information science. The two dimensions are information-gathering and information evaluation (See Figure 1).

Information-gathering is a perceptual process through which individuals organize data from their environment into information. It is

Figure 1

McKenney-Keen Model of Cognitive Style



Source: Keen, P. W. G.: The implications of cognitive style for individual decision making (Doctoral dissertation, Harvard University, 1973). Dissertation Abstracts International, 1974, 34, 5238A. (University Microfilms No. 74-9036)

characterized by a bipolar scale ranging from receptive to preceptive. The receptive person uses an inductive approach and is attentive to exact stimulus. His approach allows for a relatively unbiased, open assessment of all data. The preceptive person uses organizing precepts to screen and catalog data and focuses on the pattern rather than the stimulus itself. Continually involved in refining and extending precepts, the preceptive person is rarely overloaded by data.

The second dimension, information-evaluation, categorizes individuals by how they use information in problem-solving. It ranges from systematic to intuitive. The systematic person is methodical and conscious of a sequential, increasingly refined approach, converging to a right answer marked by logical precision. The intuitive person works on a more global level, relying more heavily on unverbalized cues and an overall sense of the problem.

Field dependence/field independence is a widely studied cognitive style dimension. It distinguishes individuals by the "extent to which the person perceives part of a field as discrete from the surrounding field as a whole rather than embedded in the field; or the extent to which the organization of the prevailing field determines perception of its components." (Witkin, et al., 1977, pp. 6-7) It has also been interpreted as a global/articulated continuum. The field independent person is analytical and is likely to impose structure spontaneously on material which lacks it. He is less attuned to social cues than the field dependent person. The field dependent person relies on the overall frame as the basis for structuring his perception and does not tend to disembed the part from the whole, but perceives globally. Research has

indicated he is more people-oriented.

The explanatory power of the McKenney-Keen model is offset in part by the effort required to gather substantiating data, as the methodology will show. Field dependence/field independence, on the other hand, can be measured reliably with a brief paper and pencil test. In addition, there is a larger body of research on the dimension which has broadened knowledge of the dimension itself and its relationship to other variables, such as task performance and career preference.

Unlike some other professional schools, graduate education in library and information science does not require a particular kind of undergraduate program in its matriculants. As a result, it attracts a diversity of students who meld their graduate education with their subject degrees to move into a wide range of professional activities. For this reason, the study hypothesized that the distribution of test scores would approximate a normal distribution. The following working hypotheses were developed to guide exploration of relationships between cognitive style and personal variables:

- Cognitive style would not differ significantly across age groups. The group is not representative of the age categories in which marked differences occur, such as in children and in persons post-retirement.
- Subjects preferring reference and administration are more likely to be more field dependent than those in technical services and subject specialization. The former are more people-oriented areas of the field and thus likely to be preferred by field dependent persons. (Greene, 1973; Konstadt and Forman, 1965;

McFall and Schenkein, 1970; Trego, 1972) The other areas are more content-oriented and more attractive, therefore, to individuals who are more analytical.

- Field independence scores will increase in order for subjects selecting school, public, and then special or academic libraries. The latter are more likely to attract subject specialists whose interest is more in content than in people.
- Subjects with social science degrees are likely to be more field dependent; those with science or art degrees more field independent. Humanities majors should fall in the middle range. (Witkin, et al., 1977)

METHODOLOGY

Data-Gathering

Data were gathered from students enrolled in several sections of a required course at the College of Library and Information Services, University of Maryland. Personal information was gathered by a self-administered questionnaire. All students (N = 179) completed the Group Embedded Figures Test (GEFT), which was used to measure field dependence/field independence (Witkin, et al., 1971). A subsample (N = 61) completed a battery of eight additional tests designed to discriminate along the two dimensions of the McKenney-Keen model.

The battery of tests used in the study is similar to Keen's battery (Keen, 1973). Some changes were required because of deletion of the original tests in the revision of the Kit of Factor-Referenced Tests. In addition to the GEFT, the tests are Choosing a Path,

Deciphering Languages, Diagramming Relationships, Hidden Figures, Hidden Words, Identical Pictures, Paper Folding, and Scrambled Words. These are pencil and paper tests, ranging in length from 3 to 24 minutes, with the entire battery taking approximately two hours. The tests, many of which were developed by Guilford, are included in the Kit of Factor-Referenced Cognitive Tests, with the exception of the Group Embedded Figures Test (Ekstrom, et al., 1976).

Reliability for each test was determined using the split-halves technique with the Spearman-Brown prophecy formula. Resulting reliability coefficients range from .659 (Deciphering Languages) to .941 (Scrambled Words), which fall in the good to excellent reliability range. Reliability for the Group Embedded Figures Test is .771.

In related research, the test scores were analyzed by factor analysis. Results support the basic structure of the McKenney-Keen model (Johnson and White, 1981). The two tests loading most heavily on each factor are shown in Table 1. The GEFT seems to relate most strongly to the receptive factor in the McKenney-Keen paradigm.

Derivation of Dimension Scores for the McKenney-Keen Model

The dimension score is a numerical score representing a tendency toward one or another of the poles on each of the two cognitive style dimensions, information-gathering and information-evaluation. The dimension score is the percentage of the total score on the dimension accounted for by one of the polar scores.

Several steps are necessary to translate individual test scores into the dimension scores. Initially the raw score distribution for each

Table 1

Cognitive Style Tests and Their Relationship to Poles and Dimensions

Dimensions	INFORMATION-GATHERING		INFORMATION-EVALUATION	
Poles	Preceptive Mode	Receptive Mode	Systematic Mode	Intuitive Mode
Tests	Diagramming Relationships Hidden Words	Group Embedded Figures Hidden Figures	Deciphering Languages Scrambled Words	Choosing a Path Paper-Folding

test is divided into septiles or sevenths, and a raw score is translated into a standardized score, based on its position within the distribution. A score of 10 on the Choosing a Path Test, for example, would be standardized as 6 since it falls within the sixth septile. Scores for the two tests loading heavily on the pole, as indicated in Table 1, are added to derive the factor score. The dimension score is computed according to the following formula, after arbitrarily designating a pole on each dimension as a pole of reference:

$$\left(\frac{\text{Factor score for identified pole}}{\text{Sum of factor scores from both poles}}\right) \times 100$$

The receptive and systematic poles are arbitrarily identified as poles of reference for the information-gathering and information-evaluation dimensions respectively.

RESULTS

The results of this study are reported in three sections. The first summarizes the demographic description of the sample. The second presents findings from the full battery of tests in terms of the McKenney-Keen paradigm, and the third describes relationships between field dependence/field independence and personal and professional characteristics. Discussion of the McKenney-Keen material is primarily descriptive. GEFT data are analyzed both from the point of view of traditional data analysis, examining the differences between group means, and exploratory data analysis (EDA), which provides techniques for graphical data display facilitating the discovery of relationships deserving further study. The aim of exploratory data analysis is to uncover trends while, at the same time, not

eliminating potentially viable lines of inquiry through an inability to determine statistically significant differences between groups. Research on individual differences is based on the notion that within group differences are as important to understand as between group differences. Since the goal of this study is to identify cognitive style dimensions warranting further study, EDA was judged an appropriate approach. The goal is to uncover circumstantial evidence in support of the working hypotheses.

Description of the Sample

The mean age of students in the large sample is 30.8, with a median of 28.4 and a mode of 27. All areas of subject degrees are represented, but humanities (46.4%) and social sciences (40.2%) predominate. About 33 percent of the social science group are education majors. Among the students who indicate an institutional preference (N = 154), about 43 percent indicate they are attracted to special libraries or commercial firms, such as data-base publishers. The next largest group (24.7%) prefer school libraries. About 17 percent of the total sample are undecided about functional preference, but the largest group prefers reference (25.7%), which involves direct personal contact with library users. The next largest group (20.1%) indicates a preference for non-print media-related tasks; this group consists primarily of future school librarians.

Students in the subsample are slightly older than the sample group, with a mean age of 31.9 years, a median of 29.4, and a mode of 27. Humanities and social sciences are still dominant degree areas with 39.3 percent and 45.9 percent respectively.

The subsample differed from the sample primarily in future preferences for future institution and function. More students in the subsample (49.2%) are oriented to careers in special libraries on information industry than in the total group. Conversely, school librarians are better represented in the sample (21.2%) than in the subsample (16.4%). Reference is still preferred most (26.5%), but the percentage expecting to go into technical services and subject specialization increased from 11.7% to 22.4% for technical services, and 7.3% to 14.3% for subject specialization.

Distribution of Dimension Scores in the McKenney/Keen Paradigm

Several studies in cognitive style have emphasized variations in cognitive style across professions, but labeling a profession with a particular cognitive style is misleading, as Table 2 indicates. Within the sample, there is considerable variation in cognitive style.

Anyone who scored 60 or above or 40 or below in a dimension is considered to have a cognitive style marked by dominance of the appropriate pole in that dimension. Seventy-two percent of the subjects demonstrate a dominant cognitive style in at least one dimension. More students showed dominance in the information-evaluation dimension, and they were more likely to be intuitive rather than systematic. On the information-gathering dimension, about 28 percent were preceptive and 19 percent receptive.

About a third of the students have cognitive styles marked by a dominance in both dimensions, and they are fairly evenly distributed. Actual numbers in these quadrants are small, however, and subsequent analysis will emphasize individual dimensions. Only 28 percent of the sample did not reveal a clearly dominant style.

Table 2

Distribution of Information-Evaluation Scores of Information Students by Information-Gathering Scores

INFORMATION-GATHERING SCORE[1]	INFORMATION-EVALUATION SCORE[2] INTUITIVE (40% and below)	NEUTRAL (41%-59%)	SYSTEMATIC (60% and above)	TOTAL
PRECEPTIVE (40% and below)	8 (13%)	5 (8%)	4 (6.5%)	17 (27.5%)
NEUTRAL (41%-59%	8 (13%)	17 (28%)	6 (10%)	31 (51%)
RECEPTIVE (60% and above)	3 (5%)	6 (10%)	4 (6.5%)	13 (21.5%)
TOTAL	19 (31%)	28 (46%)	14 (23%)	61 (100%)

[1]Percentage Receptive of Total Dimension Score.

[2]Percentage Systematic of Total Dimension Score.

Because of the small cell sizes, at this point little else can be said about the relationship of the McKenney/Keen model to the way in which information professionals operate in their roles. Additional data need to be gathered. However, there are a substantial number of cases available for further analysis with regard to the field dependent/field independence dimension of information professionals' cognitive style.

Field Dependence/Field Independence

The distribution of scores on the GEFT is summarized in Figure 2 using a stem and leaf diagram (Tukey, 1977). Scores range from 0-18, the complete possible range, and are clearly negatively skewed. The mean score is 11.3, the standard deviation is 4.76. These figures compare closely to the GEFT norms which are 11.3 and 4.15 respectively. (Witkin, et al., 1971). The GEFT was normed on a sample of undergraduate liberal arts students who, according to their findings in cognitive style research, should be similar to the present sample. In the present study both the group median and mode were higher than the mean indicating that the test was relatively easy for this population.

EDA emphasizes the importance of the median as a measure of central tendancy because it is much less susceptible to the influence of outliers than the mean. The median and the interquartile range can be used to generate a graphic display of the distribution known as the box and whiskers (Tukey, 1977). Casual comparisons between two or more distributions can be made then by arranging their respective diagrams on the same axes. This technique is used below to discuss three of the salient variables of the present study: undergraduate degree, future institution, and future function. Age, as hypothesized, did not discriminate systematically between

Figure 2

GENERAL DISTRIBUTION OF GROUP
EMBEDDED FIGURES TEST
SCORES

1	88888888888888888
1	7777777777777
1	6666666666666666
1	5555555555555555
1	4444444444
1	33333333333
1	22222222222
1	1111111111111
1	0000000000000
0	999999999999
0	8888888
0	7777777777777
0	666
0	5555555
0	444444
0	3333
0	22
0	11
0	000

individuals along the cognitive style dimensions included in this study. The age range covered by this population was not sufficient enough to introduce significant variation.

Box and whiskers diagrams of GEFT scores broken down by undergraduate degree are presented in Figure 3. It should be noted that history, traditionally considered one of the humanities, and education, a social science, are listed separately rather than within their broader disciplines. History and education are the two major undergraduate degrees represented in the sample. History majors tend to focus on the areas of archives, rare books, or subject specialization while education majors are interested in school libraries.

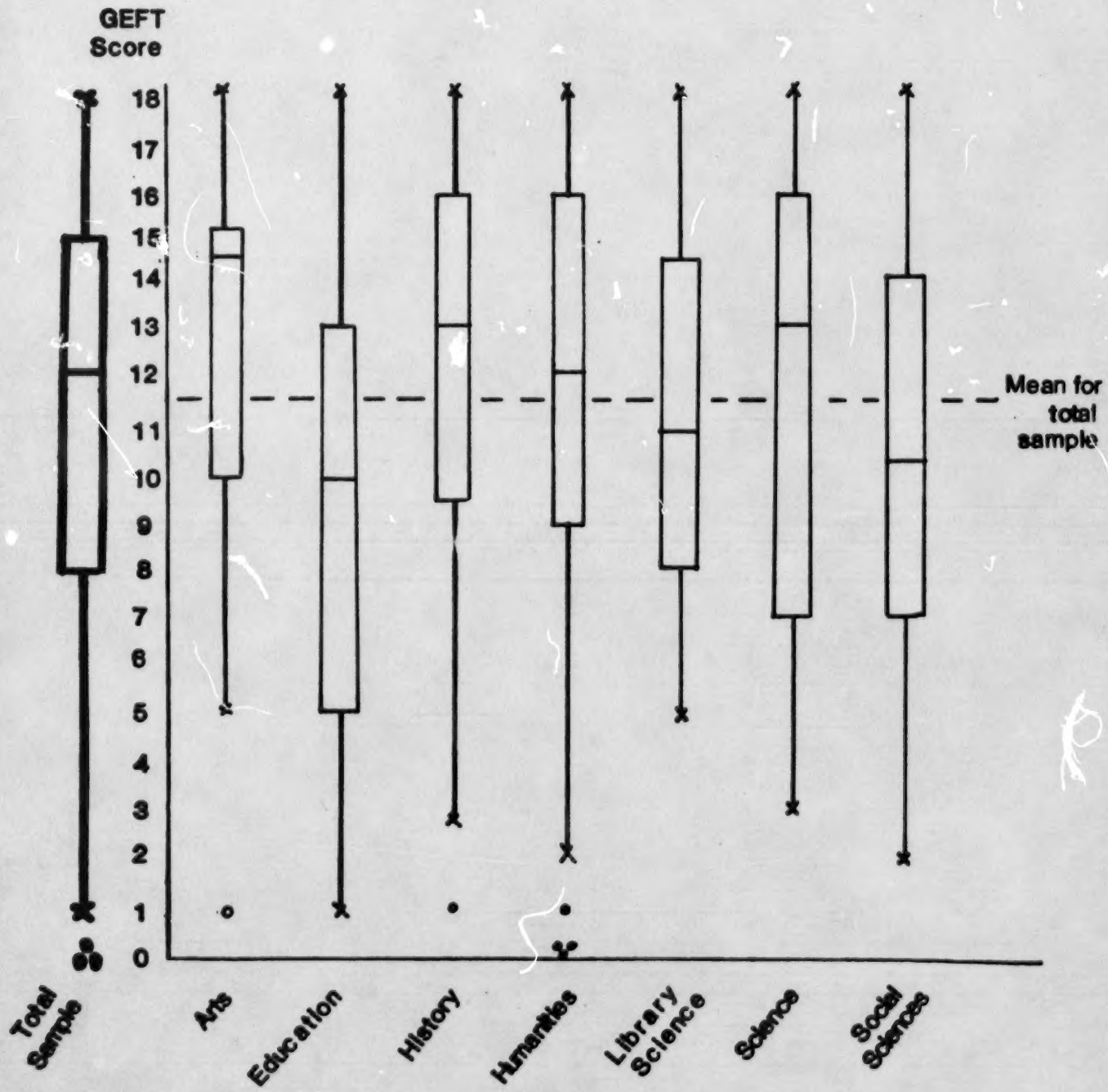
It can be observed from the box and whiskers that the distribution of history scores on the GEFT is most similar to that of undergraduate humanities majors. Likewise, education majors tended to score in a pattern similar to other social sciences. In each case, the similarities with their home field are much greater than their similarities with other disciplines considered in this study.

Education subjects present an additional characteristic. They have the most constrained distribution of scores--i.e., they exhibit a strong tendency to cluster around the median. The interquartile range for education majors is the smallest of all of the groups in the sample. Also, the median for both education and social science falls below the population mean indicating a relatively greater field dependence, a finding consistent with other research (e.g. Chung, 1966).

Subjects from the sciences present a situation which demonstrates one of the strengths of EDA. Since there are only nine subjects in the science group comparisons with other groups are difficult to make due to a lack of statistical power. At the same time the science group appears to be

Figure 3

DISTRIBUTION OF GROUP EMBEDDED FIGURES TEST SCORES BY UNDERGRADUATE MAJOR



distributed over a wide range of scores making specific observations about the group tentative at best.

Library science, the other group with a median below the population mean, compares closely to the social sciences. One major difference is that a relatively smaller proportion of library science subjects are broadly distributed in the first quartile; subjects falling below the lower hinge of the distribution tend to be clustered close to the hinge itself.

Analysis of variance was conducted using the SPSS program breakdown. The differences are not statistically significant. Under normal conditions this would be cause for concern but in exploratory research, and with the support of EDA, sufficient circumstantial evidence can be found to suggest that the GEFT appears to roughly, yet systematically, discriminate on the variable "degree." On the basis of previous research in cognitive style it was hypothesized that social science majors, including education majors, tend to be more field dependent than their peers in the sciences and the arts. Comparisons of the medians and the distributions of those groups appear to support that hypothesis. It is at least supported to the degree that further study is advisable.

Another variable of interest in this study is the subject's choice of future institution. It was hypothesized that subjects choosing different types of library and information settings would score in systematically different ways on the field dependent/field independent dimension. Analysis of variance failed to confirm the hypothesis at a statistically significant level. However, EDA provides enough support for the argument to suggest continued study of the question. The hypothesis was that there would be significant differences and that the order from most field dependent to

most field independent would be school, public, special, and academic. A comparison of means for the groups suggests that the order is school, special, public, and academic, but a comparison using EDA and the box and whisker technique hints at another order.

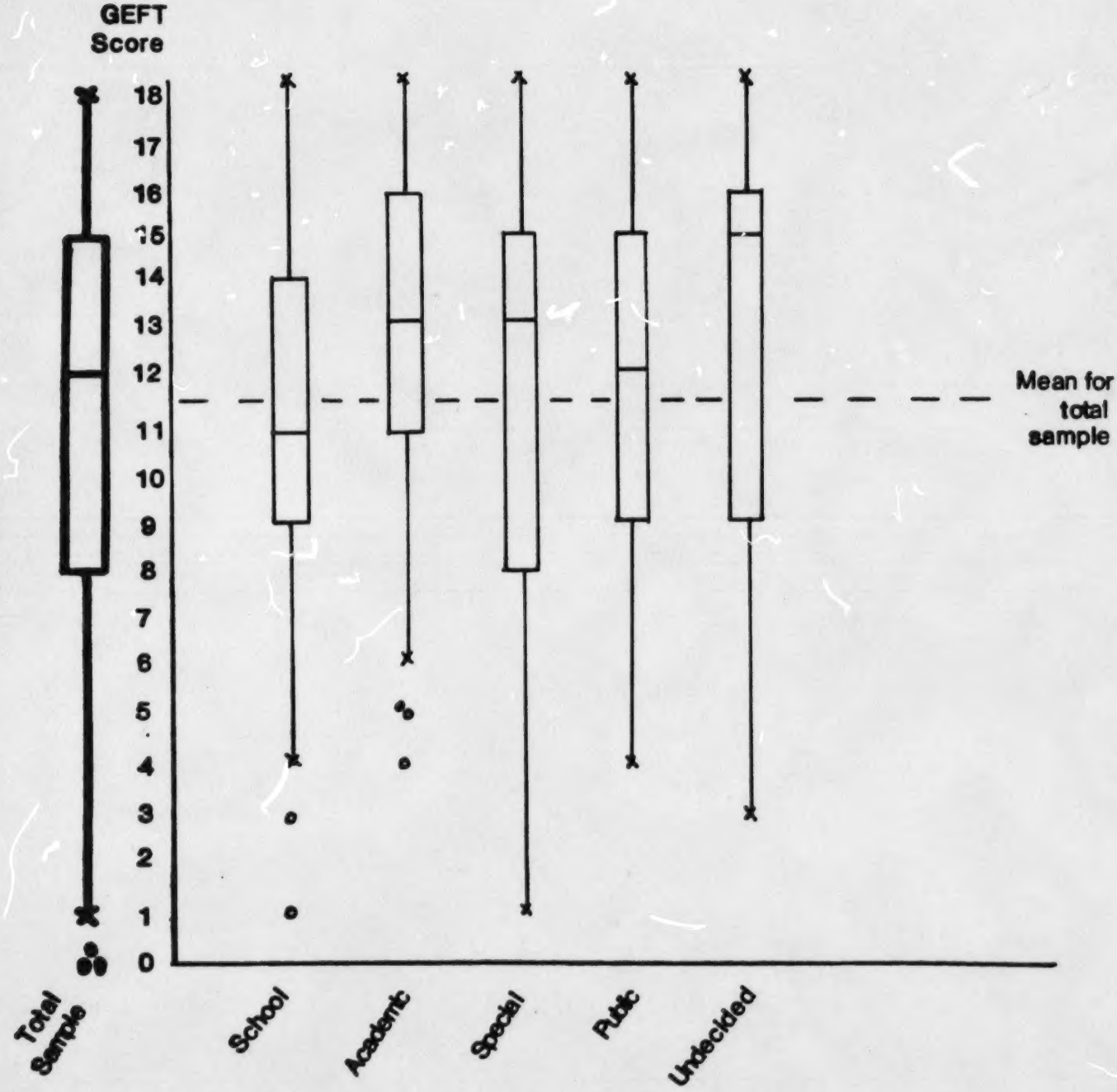
Figure 4 provides a graphical description of the GEFT distributions according to the variable "future institution." A comparison of the medians follows the hypothesized order with the exception that special and academic librarians have the same median score. But the distribution for academic librarians is clearly more skewed toward field independence than the special librarians' distribution. The special librarians are also more widely distributed within the interquartile range than the academic librarians. It should be noted that the lower hinge of the interquartile range for special librarians is the lowest of the five groups displayed. In contrast, for example, the school group tends to be fairly tightly grouped around the median within the interquartile range and to have long whiskers indicating a widely dispersed distribution in quartiles 1 and 4.

The "undecided" group presents an interesting problem. They exhibit the highest median, the greatest tendency toward field independence, of any group. One possible explanation is that they are less in need of a pre-specified context than some of their more field dependent peers and can operate under conditions of more uncertainty.

Future function within the profession is the final variable to be discussed in this study. It is perhaps also the most educationally significant in that professional school curriculum focuses on the tasks and roles inherent in each defined function within the profession. In fact, curiosity about the interaction of task variables and cognitive style motivated the present study. It was hypothesized that roles perceived

Figure 4

DISTRIBUTION OF GROUP EMBEDDED FIGURES TEST BY INSTITUTIONAL PREFERENCE



as people-oriented, such as reference librarian and library administrator, would both draw more field dependent individuals and require more field dependent skills. At the same time, however, demands made by technology on people performing those roles create a certain degree of cognitive strain, given their relatively more field dependent orientation.

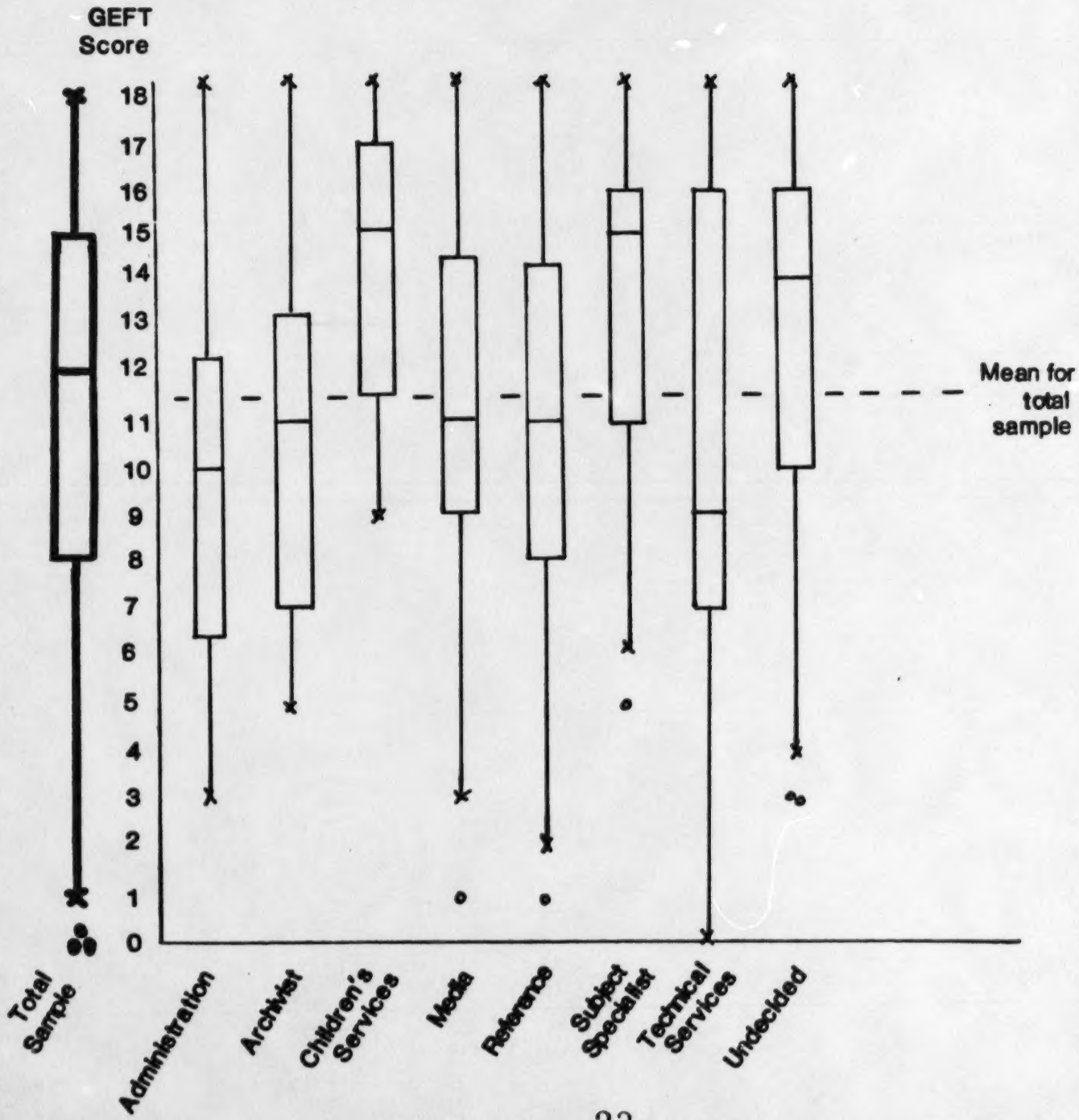
Future function distributions are graphically exhibited in Figure 5 using box and whiskers. The hypothesis is generally supported but there are several surprises. The technical services group, which includes individuals interested in acquisitions and cataloging, among other things, has the lowest median and the widest interquartile range. In addition, the tails of the distribution for the technical services group tend to be relatively short, indicating a wide dispersion of cases but over a shorter range of scores.

Reference librarians and administrators have a median below the population mean and are more field dependent relative to the total population. Surprisingly, however, archivists also have a median score lower than the population mean. The archivists' scores tend to cluster close to the upper hinge within the box and to have a long upper whisker. Archivists' scores constitute most of the historians' scores toward the field dependent pole.

Results of analysis of variance are statistically significant ($p < .05$). This finding confirms the hypothesis that individuals choosing particular future functions within the field tend to be differentiated on the field dependent/field independent dimension of cognitive style in some systematic way. It also suggests that differential educational treatments might be appropriate if there is a mismatch between the requirements of the chosen function and cognitive style. The more realistic concern, however,

Figure 5

DISTRIBUTIONOF GROUP EMBEDDED FIGURES TEST SCORES BY FUNCTIONAL PREFERENCE



is that different tasks within each role require different cognitive approaches. Reference librarians, for example, have been shown in this study to have a relatively more field dependent orientation than their peers. Field dependence is an appropriate style for that part of the reference librarian's role requiring interaction with other people, such as in question negotiation. When confronted with analytical tasks, field dependent individuals are at a relative disadvantage and yet reference librarians must be prepared to handle analytic tasks when they design and conduct computer searches, for example.

CONCLUSIONS

The results of this study suggest that a) professionals in an apparently homogeneous graduate school population can be successfully discriminated along one or more cognitive style dimensions; b) those discriminations have at least face validity; c) approximately three-fourths of the sample demonstrate a distinctive cognitive style along at least one dimension of the McKenney/Keen model; and d) some systematic and statistically differences exist between subgroups within the population. A limitation of the study from the point of view of the McKenney/Keen paradigm arises from the small sample size and the consequent inability to explore individual differences within each cell of the model. Further study in that direction is recommended.

Cognitive style is a construct which can be used effectively to study the behavior of students in professional school vis a vis particular tasks, courses, and educational approaches. Within library and information science education, research needs to be done on the relative effectiveness in task performance of students with particular cognitive styles, on

the feasibility of teaching students to monitor their cognitive approaches and perhaps alter strategies to suit the task, on curricular modifications necessary to integrate field dependent students into a profession which is becoming more technology-dependent.

FOOTNOTES

Note: The arrangement of authors' names is alphabetical and does not denote primacy of authorship. Both share equally in the conceptualization, analysis, and interpretation reflected in this paper.

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[1]This method was developed by Keen and is based on considering cognitive style as more a relative than absolute measure. A more detailed explanation of the method of scoring and the basis for this approach is presented in Keen, 1973, and Johnson and White, 1981.

[2]Keen used the model to classify graduate business students. His distribution is similar with a lower percentage considered intuitive (27%) and a higher percentage systematic (36%). A lower percentage is classified neutral on both dimensions (48% on information-gathering; 37% on information-evaluation). Business students with dominant styles in two dimensions tend to cluster in the intuitive-preceptive and systematic-receptive quadrants, unlike the information students who are more evenly distributed among the quadrants.

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